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PRELIMINARY REPORT ON THE WATER SUPPLY FOR THE "CAREY ACT" PROJECT OF THE UINTA LAND AND WATER COMPANY

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GENERAL PLAN

The project contemplates the irrigation of approximately 25,000 acres of land in Uinta County, Utah; the water to be taken from Dry Fork Creek, a tributary of Ashley River. From the diversion point on Dry Fork, the water is to be run thru a tunnel into the head of Mosby Canyon and thence down the natural channel of Mosby Creek to be later diverted into the Deep Creek Reservoir for storage and on to the lands for irrigation.

SOURCE OF SUPPLY

The Dry Fork Creek from which the water is to be derived rises in the heart of the Uinta Range of Mountains at an elevation of 12,000 feet, and flows in a general southeasterly direction for 28 miles, to its junction with Ashley Creek at a point 8 miles northwest of Vernal. The proposed diversion point is 15 miles above the mouth of Dry Fork, at an elevation of 8400 feet.

WATERSHED

The drainage area above the diversion point if 13 miles long, with a maximum width of 7 miles, and covers 28,500 acres. The entire area is densely timbered, being a part of the Ashley National Forest, and is entirely uninhabited. The area is surrounded by mountain ranges running from 9500 to 12,000 feet in elevation. The native rock is red sandstone, the slopes are steep and the upper canyons are heavily glaciated. The numerous small lakes within the watershed are all of glacial origin.

RAINFALL

No records of rainfall in this region are available, as the U. S. Weather Bureau has no stations whatever in these mountains nor in the higher altitudes elsewhere in the State. A recent government report on "Rainfall in Utah" says:- "It varies from 6 to 25 inches annually at stations between 2800 and 7000 feet, and it is probable that as much as 30 inches or more falls at some places at the higher levels". Judging from the location and topography of this region, it is safe to assume that no part of Utah has a greater precipitation than does this watershed. The prevailing storm winds are from the southwest, and as the surrounding mountains are highest on the northeast, the conditions are most favorable for a heavy rainfall.

The mean annual precipitation at Vernal, altitude 5300 feet, is 10 inches. As no records have been kept elsewhere in this vicinity, it is difficult to estimate what the rate of increase with altitude would be from Vernal to the head of Dry Fork . But from the reports of increase of precipitation with altitude elsewhere under similar topographic conditions, it seems that 3 1/2 inches per thousand feet would be a safe estimate to make in this case. This would give an annual precipitation of 31 inches, which agrees with the Weather Bureau's estimate above quoted. I consider 30 inches a safe estimate of the mean annual precipitation over the whole of the drainage area under consideration.

RUN-OFF

Conditions on this watershed are most favorable for a high ratio of runoff to rainfall. The slopes are very steep, there is but scanty soil, and the native rock is solid and of uniform texture; thus reducing the absorption losses to a mimimum. Most of the year's precipitation occurs as snow during the winter months. As the snow is all sheltered from wind and sun by the dense timber growth, the evaporation from the snow surface will probably not exceed 2 inches of water during the season, and the total evaporation during the remainder of the year will, on account of the low temperature and protection from wind, be slight.

Considering these unusual conditions and applying formulas and diagrams of the best authorities on the subject, we determine the most probable runoff from a yearly precipitation of 30 inches to be about 23 inches. This would give a total annual flow from the drainage area of 55,000 acre-feet.

GOVERNMENT REPORTS

The only stream gagings made by the U. S. Geological Survey on Dry Fork Creek are those of Mr. H. S. Reed in 1901 and 1904, as reported in W. S. Paper No.133. According to this report, the flow measuredat a point 1 mile below the Company's proposed Diversion point on Aug. 20, 1901 was 96 second-feet. It is also stated that 1901 was one of the dry years but that recent rains had raised the stream higher than usual at the time the gaging was taken. This single gaging under such circumstamces is of little value in the present investigation. The gagings of 1904 cover a period from May 12th to July 15th, but were taken at the mouth of Dry Fork Creek 15 miles from the proposed diversion point, and therefore need not be considered in this connection.

GAGINGS

Early in the season of 1912, I established a gaging station on Dry Fork Creek at the proposed diversion point. This was correctly rated with a Price current meter, and gagings taken at that point from 2 to 4 times a month till the present time. The flow on May 27th at the beginning of the high water season was 210 second-feet, increasing thence to the maximum of 420 on June 5th, thence falling gradually to 180 on June 30th and 83 cusecs on July 30th. The following table gives the complete record for the season:

May 27	210	cusecs	July 2	160	cusecs
June 4	420	"	" 12	112	"
" 10	300	"	" 30	82	"
" 15	210	"	Aug. 10	56	"
" 20	220	"	" 24	50	"
" 25	230	"	Sep. 5	65	"
" 27	212	"	" 19	46	"

The accompanying discharge curve shows the approximate flow for each day of the season, and the total discharge in acre-feet. This gives a total amount from May 1st to Sep. 27th of 37,600 acre-feet. Placing the average flow for the rest of the year at the very safe estimate of 45 cusecs, would give 57,000 acre-feet as the total discharge for the year 1912. This agrees very closely with the results already obtained above from the consideration of rainfall and runoff.

It appears however from all reports that the present season has been a rather unusual one in many respects. The last winter was a mild one and the snowfall in the mountains was rather light. The spring was late and the flood season was about 2 weeks later than is usual. The presipitation during the spring and early summer, however, was above the average, and the flow reached a lower minimum in the early autumn than is reported heretofore. Considering all of these points however, it seems that the total results for the year 1912 are not far from the average, and the error if any, in taking this year's records as a guide to the available water supply, will probably be on the side of safety.

This amount of water if all properly conserved will irrigate the entire 25,000 acres included in the project, allowing 2 acre-feet per acre per annum on the upper unit of 10,000 acres where the absorption losses are light, and 2 1/2 acre-feet per acre on the lower 15,000 acres of the project.

I is also a part of the Company's plan to store and use the waters of Paradise Park drainage area amounting to 6000 acre-feet per annum, also the flood waters of Mosby and Deep creeks amounting to about 5000 acre-feet; thus insuring an ample supply for the entire area included in the project.

STORAGE

In order to control and properly distribute the water according to the requirements of the land for most efficient irrigation, storage reservoirs are a necessary part of the project as a whole, altho the upper unit of 10,000 acres can be served by the regular flow of the stream without storage. For this purpose the Company has secured four reservoir sites; one on Deep Creek with a capacity of 9200 acre-feet and three in the mountains with a combined capacity of 4900 acre-feet.

By starting the irrigation season with all reservoirs full, the upper serervoirs can be drawn upon to supply the requirements during April and May and again replenished from the surplus of the June flood, thus doing double service. The following table shows the available supply and the required draft for each month of the irrigation season, and the manner of handling the same thru the reservoirs. Proper deductions are also made for evaporation. All quantities in the table are given in acre-feet.

Month	Flow	Required	Left in lower resv.	Left in upper resvrs.	Evaporation	Waste
Winter	18100	2000	9200	4900	---	2000
Apr.	3300	4000	9200	4100	100	----
May	8700	13000	8900	----	100	----
June	17900	15000	6700	4800	200	----
July	7600	12000	2100	4900	200	----
Aug.	4100	9000	----	1900	200	----
Sep.	3300	4000	----	1200	---	----

The above table shows a surplus of 1200 acre-feet in the reservoirs at the close of the irrigating season. It also shows that one acre-foot per acre is allowed for all the land after the first of July, thus insuring against any shortage for the latter part of the season. The above distribution can be handled by a tunnel capacity of 220 cubic feet per second; since the upper reservoirs are above the tunnel and can handle the peak of the flood, which would otherwise run to waste or require a greatly increased tunnel capacity to carry it to the lower reservoir. In the above table no account was taken of the flood waters of Mosby and Deep Creek drainage areas, all of which would go to the lower reservoir as an additional safety factor.

DRY FORK SINKS

About 2 miles below the proposed diversion point, the waters of Dry Fork Creek sink into the porous stream bed, leaving the channel for miles below entirely dry for the greater part of the year. This peculiar condition is true not only on Dry Fork but on Ashley Creekand other streams to the eastward. On this subject the government report above mentioned gives the following:

"A peculiar feature of the streams between the Uinta River drainage area and Green River is that at some part in their course they disappear except during the spring floods, and that all with the exception of Dry Fork, reappear again miles farther along every year. Dry Fork disappears seemingly altogether in one sink, where it forms a pool, about 12 miles above the junction of this branch and Ashley Creek proper. - - - The pool is apparently bottomless; the water in its larger end has a slow circular motion, but whether this is caused by the incoming stream or by suction from below could not be determined. - - -Seven miles below the pool are located several springs, the upper and largest one being a hole 25 feet in diameter. This pool was perfectly dry, but at the lower ones there was an outflow of 33 second-feet. A resident of Dry Fork settlement since 1879 stated that only once before, to his knowledge, had these springs furnished water after the subsidence of the usual spring freshet".

RECENT INVESTIGATIONS

A series of thoro personal investigations carried on for the past several months at different points along Dry Fork Creek reveal conditions of flow etc. differing somewhat from the findings of Mr. Reed in 1901 as reported above. In the first place, the sink referred to as the seemingly bottomless pool now appears to be quite thoroly silted up and has a maximum depth of not over 8 feet. The stream at all stages flowed thru this pool without apparent diminution. The sinking began about a mile above this pool and continued for a mile or more below the pool. The water seemed to gradually disappear in the porous gravel and boulders of the stream bed, till the stream had wholly vanished. In this respect conditions this year seem to differ somewhat from those reported in the past. Parties who have known this region for many years, state that in past years the pool has claimed the greater share of the lost waters, tho the formation has changed somewhat from year to year.

As an example of the action of the stream during the present year, I give below the results of gagings taken along the stream on July 18th:

At the gaging station located at the proposed diversion point, the flow was 100 second-feet. One mile below the diversion point the gaging showed 92 second-feet. This diminished rapidly to 42 cusecs at the above mentioned pool 2 miles below the diversion. At the north fork junction 3 miles farther on, the flow was only 12 cusecs, to which 10 cusecs were then added from the North Fork. This flow of 22 second-feet fully disappeared within the next mile. The stream bed was then dry for 2 miles. The springs 8 miles below the diversion point had a combined flow of 55 cusecs, which diminished to 30 before reaching Ashley Creek. The following table shows the flow in second-feet for different points along the stream at different dates during the season:

Place	July 12	July 18	July 30	Aug. 10
Gaging station	112	100	82	56
One mile below	100	92	75	48
2 miles below (pool)	50	42	38	22
3 miles below	45	--	35	18
5 miles below (North Fork)	15	12	6	0
From North Fork	12	10	7	5
6 miles below	--	0	0	0
7 miles below	--	0	0	0
8 mi.below.(opp. Sprngs)	8	6	3	0
From springs	54	51	37	11
Head of Dry Fork valley	50	48	30	--
Dry Fork village	45	42	--	--
Entering Ashley creek	35	30	--	10

All the normal flow of Ashley Creek below its junction with Dry Fork is appropriated and used for irrigation in Ashley Valley. Also in Dry Fork valley about 800 acres are irrigated from the springs above mentioned, which however in ordinary seasons cease to flow quite early in the summer. The government report above referred to states that "after the subsidence of spring floods, the main stream receives nothing from Dry Fork". Consequently the Ashley Valley irrigators are not dependent upon the Dry Fork springs for any part of their supply. The Dry Fork Valley settlers however, irrigate their 800 acres from the Dry Fork springs. Also in Ashley Gorge a few miles east of the Dry Fork springs, are located certain springs which flow the greater part of the year and therefore form part of the water supply for Ashley valley.

TESTS

The question has often been raised as to whether these springs in Ashley Gorge as well as the ones in Dry Fork are not fed thru some underground passage by the water sinking in Dry Fork canyon below the proposed diversion point. To determine this question, I conducted a very thoro investigation, which included among other things, a series of color and chemical tests by methods approved by two of the best consulting engineers in the West.

The color test consisted in disolving permanganate of potassium in the stream above the sinks, and testing samples taken each hour for several days at the springs in Dry Fork and Ashley Gorge for the appearance of the color. Baboratory tests showed the color, even in minute quantities, to be persistent in this water. Preliminary tests on the stream also showed that the color carried strong for several miles above ground; but in three separate tests made at different times and at different stages of the stream flow, no trace of color appeared at any of these springs.

The chemical test employed was what is known as the chlorine test, and consisted in disolving large quantities of common salt at the sinks and testing for an increase in the chlorine content at the springs. Silver nitrate was the reagent used, with potassium bichromate as color indicator. This makes a very delicate and decisive test; but in two sep arate tests under varying conditions, no trace of chlorine appeared at the springs.

In these tests, I was assisted by three other men, including a civil engineer and a chemistry professor. No pains were spared to make the tests as thoro as possible, ad the results seem to justify the conclusion that there is no direct connection between the Dry Fork sinks and the springs in either Ashley Gorge or Dry Fork canyon.

The geologic structure of the region furnishes additional evidence on the subject. The native rock is principally a medium soft sandstone, underlaid with limestone, which outcrops in a few places in the canyon. Sandstone is a great absorber of water, and limestone is liable to fissures, fault planes and solution cavaties, all of which might readily bob the stream of its flow. The stratification all thru the region is fairly uniform, with an average dip of about 5 degrees to the south. The Dry Fork springs are located 6 miles east-southeast of the sinks, and the Ashley Gorge springs are 10 miles nearly due east of the sinks. With the country dipping tb the south, it seems quite unlikely that the water which sinks, even if it found an underground channel, would even reach so remote a point at right angles to the dip. The sinking is also spread over a large area, and differs in this respect from year to year, tho the effect is the same in all cases. About 15 years ago, an attempt was made to save the waters of this stream by constructing a flume around the sinks. The flume was constructed and for 6 weeks the stream flowed thru it, but the springs remained unaffected by the change. The water, however, soon sank again after being released into the channel, and the enterprise was a failure. All these points seem to indicate that most of the water which sinks in Dry Fork finds its way down thru the porous rocks to the great mass of underground water and is lost to all practical purposes; and the proposed diversion of the same by the Company will therefore not impair the rights of any water users below.

Observations of temperature were also made as a part of the recent investigations, and showed that the temperature of water was the same in the several springs of the Dry Fork group and was constant at all seasons, regardless of the varying temperature at the sinks and elsewhere at the surface, indicating that the water came from considerable depth and had been long underground. The small amount of underflow which came to the surface half a mile above the springs, was of higher and varying temperature.

The six springs of the Dry Fork group diminished slowly and gradually in volume, regardless of the varying flow above the sinks till the water table was lowered to the level of the upper spring. Then the springs, one by one, ceased to flow, in order of their relative elevation, till all were dry, reducing the flow from 20 cusecs to zero within 12 days, while the stream above the sinks had remained nearly constant.

The Ashley springs flow much more uniformly and much later in the season than do those in Dry Fork, and at some seasons of the year have a flow even greater then the amount sinking in Dry Fork, which is positive proof that they draw their supply from other sources. A competent witness who has lived near these springs for many years varifies this conclusion.

Government reports on Ashley Creek give the drainage area and probable runoff, and draw the conclusion that much of the water is permanently lost and that the Ashley drainage area is capable of furnishing very much more water then ever flowed from the gorge (see Third Annual Report Reclamation Service). Also on Dry Fork the drainage area between the sinks and the springs is larger than the total area above the proposed diversion point, and is capable of furnishing twice the flow of all the Dry Fork springs combined.

CONCLUSIONS

Since the Company has the only rights allowed by the State Engineer's Office on the waters of Dry Fork above the sinks, and since it is the inevitable conclusion from the above evidence that any rights to the waters below that point will in no way be affected by the Company's proposed diversion, the project is assured of a safe and sufficient water supply to guarantee the success of the enterprise.

Respectfully submitted,

(signed) J. Winter Smith,
Civil Engineer.